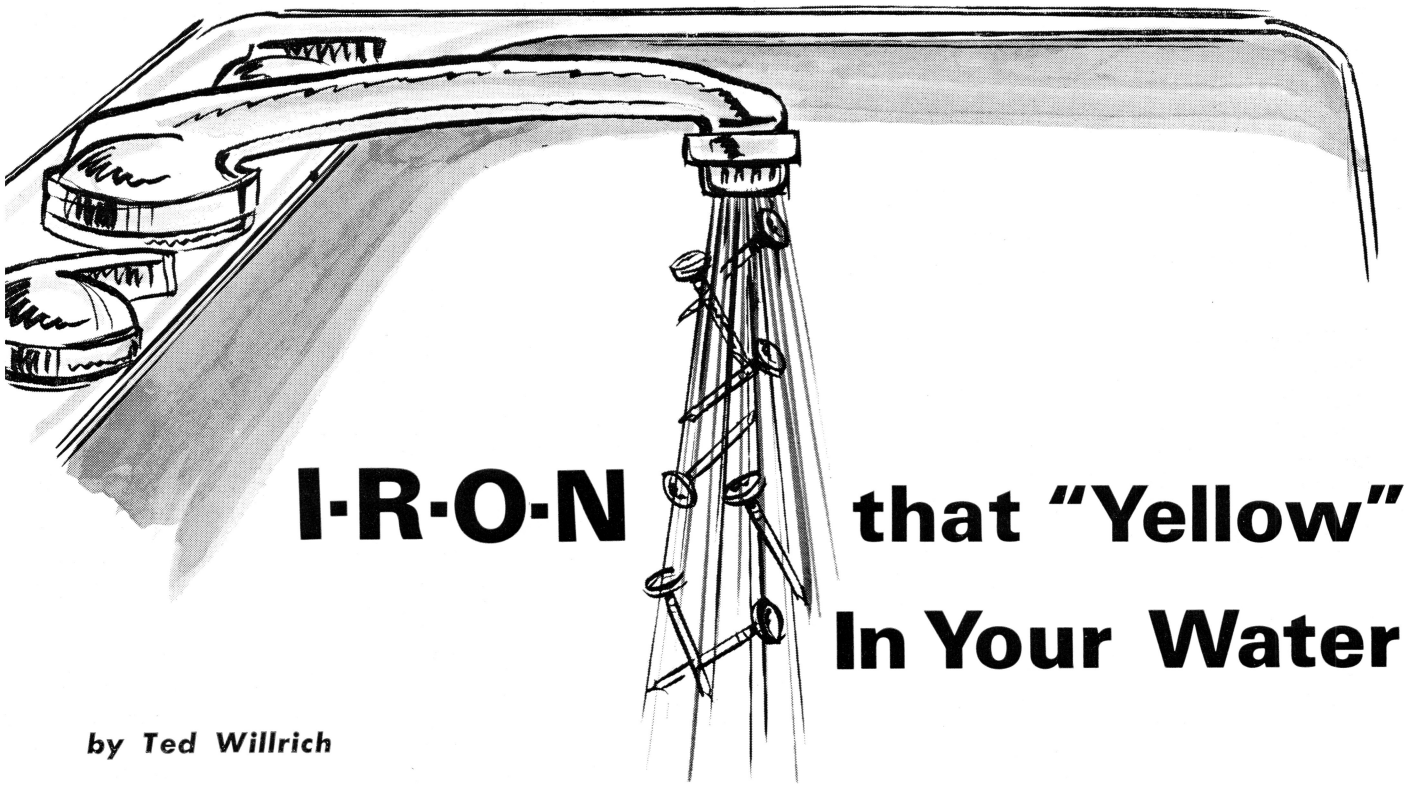
Iowa Farm Science

Volume 22 | Number 6 Article 3

12-1967

# I-R-O-N - That "Yellow" in Your Water

Ted Willrich
*Iowa State University*



# I-R-O-N that "Yellow" In Your Water

**by Ted Willrich**

YELLOW SPOTS on newly laundered clothes—an unsightly yellow stain where the faucet drips in the sink—a glass of murky, yellow water!

They all spell out the same problem in the family water supply: I-R-O-N. And iron is likely to be most anywhere in Iowa's underlying ground waters. But it's not everywhere. One well may draw its supply from a spot where water has percolated through iron-bearing geologic deposits, while a well on adjoining property may miss that deposit completely and come out crystal clear.

"But why," ask some folks, "is the water clear when we first draw it? It only turns rusty looking after it has stood awhile."

In this case, the iron in the water is a soluble or "inorganic" iron. It is dissolved in the water so you can't see it. If you remember your chemistry, you'll recognize this dissolved state as the "ferrous" form of iron.

After such water stands in the open for a short while, the iron combines with the oxygen from the air—or oxidizes, becoming the "ferric" form of iron. We see the iron in this undissolved or precipitated state as it turns the water a murky, yellowish color.

The same thing happens when water is chlorinated. Oxidation of the iron takes place and the water turns yellow. This is one reason chlorine bleach sometimes plays havoc in the laundry, causing more yellowing of the wash than if it had not been used with water of this type.

Iron is also found in water in an "organic" state. This means the water actually contains organic compounds and the iron is linked in some way within the organic molecular structure. But this is found mostly in surface water and seldom in well water.

One other cause of yellow water may be rust-colored bacteria. These are called "iron bacteria" because they use iron from the water or from iron pipes as their food. They collect iron inside their cells then mass together inside the water pipes. Occasionally, you may see clumps of yellow bacteria spill from the faucet into your glass. Iron bacteria do not cause disease, but they will leave splotchy yellow stains on laundry.

You no doubt know by the appearance of your water, laundry and sink if you have troublesome inorganic iron present. But you need to know exactly how much iron is present if you're planning to remove it. As little as 0.3 parts of iron per million parts of water (0.3 ppm) can cause rust-colored staining of laundry and plumbing fixtures.

The State Hygienic Laboratory at Iowa City will test your water for iron content if you ask specifically for an iron test when sending them a sample. To collect your water sample, follow these guides in order to get a true test:

1. *Draw the water at the first possible tap after the well pump or the house inlet. Do not sample water that has gone through the water heater or any water treatment unit such as a softener.*
2. *Let the water run at least 10 minutes before taking the sample.*
3. *Use only the bottle and mailing carton provided by the laboratory. A testing fee of*

TED WILLRICH is associate professor agricultural engineering and extension agricultural engineer.

*$2 must be sent with the sample. State that you want an iron test.*

Results of this test will tell you how much inorganic iron is present in your water. However, if you suspect the presence of iron bacteria, then you need to supply them with another sampling of an entirely different nature.

This sample should contain visible clumps of iron-colored matter. Best place to collect this type of a sample is from the toilet flush tank. Scrape some of the slimy coating from the tank wall to include with the water in the sample. Then on your enclosure slip to the laboratory be sure to request an *iron bacteria* test and include a $2 testing fee. Your reply from them will tell whether or not bacteria were found, but not "how much." The amount is not necessary to know on iron bacteria as the treatment is the same—for a little or for a lot.

### What to do about "yellow" water

There's no one simple solution to solving your iron problems. Sometimes it takes a combination of different treatments to give you trouble-free water. The use you plan to make of the water makes a difference in the treatment you might choose, and the type of iron problem you have to cope with also helps determine what you might do.

Here are some possibilities to consider:

A. *For inorganic iron in water to be used outside the home:*

1. Separate water and air in an offset pressure tank to limit oxidation and accumulation of iron in the pressure tank and pipes, or
2. Inject a polyphosphate solution into the well or at the pump to slow up oxidation of dissolved iron following exposure to air.

B. *Alternative treatments for inorganic iron in water to be used in the home:*

1. Install a water softener to remove dissolved iron only.
2. Install an oxidizing filter and a water softener to remove both oxidized and dissolved iron.
3. Spray or spill water into a storage and settling tank to remove both oxidized and dissolved iron.
4. Install a pressure aeration and filtration system to remove both oxidized and dissolved iron.
5. Install a continuous chlorination and filtration system to remove both dissolved and oxidized iron in unlimited amounts.

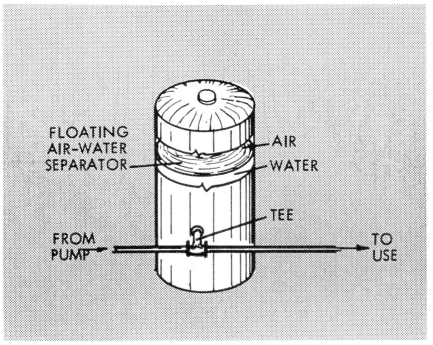



**FIGURE 1.** An offset pressure tank containing an air-water separator minimizes oxidation of dissolved iron in the water.

C. *Alternative treatments for iron bacteria plus inorganic iron in water to be used either inside or outside the home:*

1. Periodically shock chlorinate the well and distribution system to control iron bacteria. Use compressed air to blow masses of bacteria out of the pipes. Then use one of the methods above to remove inorganic iron. For details on shock chlorination, see "Is It Good Water?", April 1967, or reprint FS-1216, or
2. Install a continuous chlorination and filtration system to control iron bacteria.

Now—which method should you choose? After you've received your water analysis from the State Hygienic Laboratory, check out the control possibilities and see which might work best in your case.

Here are the principles involved in each of the choices listed above:

### Water-Air Separator

A water-air separator system is not meant to remove iron from your household water supply or to protect your pump from iron deposits. But it will reduce pipe and valve clogging problems around the household and farmstead.

Here's the way it works. You install a water-air separator, such as a floating diaphragm, in an offset pressure tank. This minimizes oxidation of the iron in the water while it's in the pressure tank and piping system.

So with the float inside the tank, most of the air is kept from hitting the water. And most of the water goes past the offset tank without entering it. Therefore the iron remains dissolved until it is drawn from the faucet.

To keep the pressure tank, waterers and other vessels in the system as free of oxidized iron as possible, flush them out periodically. Use compressed air, if necessary, to blow accumulated iron out of the pipes. Plastic or copper pipes with smoother surfaces are easier to keep clear than galvanized iron pipes.

### Polyphosphate Treatment

The phosphate treatment can partially prevent iron oxidation, pipe corrosion and scale formation. However, it won't remove iron and scale deposits that have already formed in pipes, nor remove oxidized iron—nor will it always prevent dissolved iron from staining clothes in the washer.

Polyphosphate should be injected into the well or into the water system at the pump before iron can oxidize. To do this, install an adjustable rate-of-feed solution feeder for injecting a food-grade polyphosphate solution.

A "pot feeder" type solution feeder lacks adequate rate-of-feed control. Usually, it's not satisfactory, especially on systems where the water contains more than 1 ppm of dissolved iron.

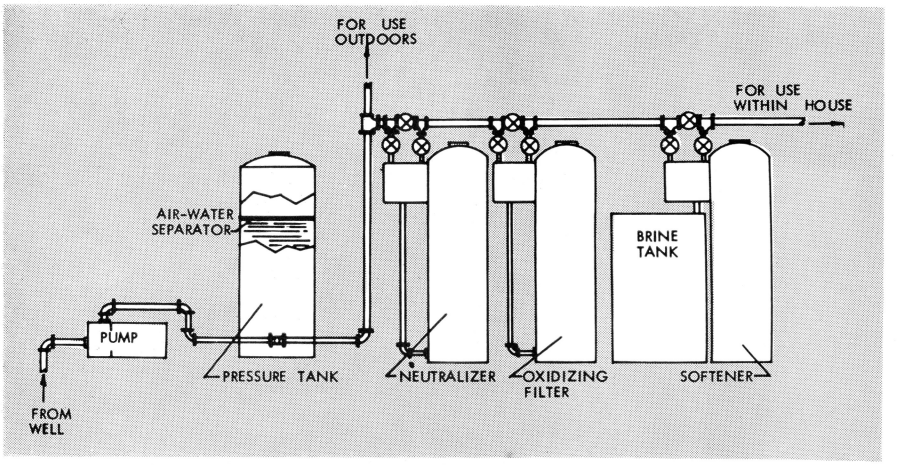



**FIGURE 2.** An oxidizing filter followed by a water softener removes both dissolved and oxidized iron. A neutralizer tank may be needed to correct pH.

### Water Softener

As well as removing hardness minerals, a water softener will remove limited amounts of dissolved iron. How much it can remove varies with the water properties, the type of regeneration and backwashing controls, and the type of ion exchange material (zeolite) used.

Frequent and thorough backwashing and regeneration are essential to maintain a clean zeolite bed. So, if possible, equip your home-owned water softener with automatic backwashing controls if it must remove iron and hardness minerals. In regenerating the softener, salt brine is added to the zeolite which restores its capacity to remove nuisance minerals from the water.

Recommendations of water softener manufacturers differ with their products. Some recommend their water softeners to remove iron concentrations as high as 15 ppm. Others discourage the use of their softeners if the iron exceeds 1 ppm unless an iron filter is installed ahead of the softener.

But if you're counting on removing iron with the water softener, regardless of the type, prevent oxidation of the iron as much as possible in the pressure tank. Otherwise, the zeolite bed becomes fouled with oxidized iron, and quickly loses its ability to remove hardness minerals as well as the dissolved iron. This may mean installing a water-air separator in the pressure tank to limit the oxidation. But, don't use the phosphate treatment ahead of a softener as this interferes with removal of both iron and hardness minerals.

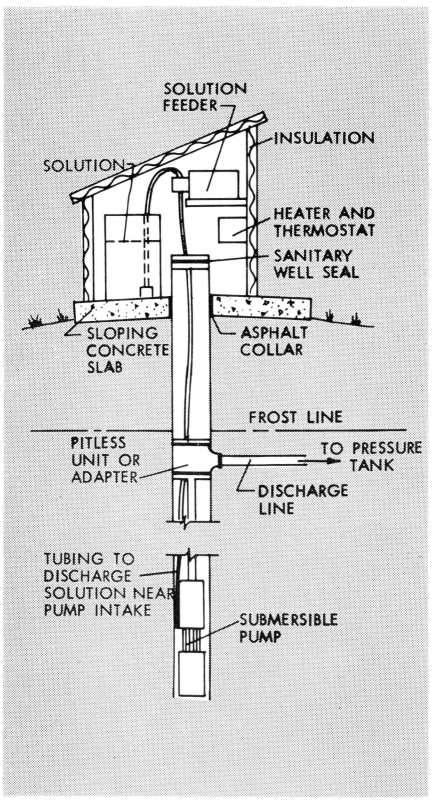



**FIGURE 3.** Down-the-well injection of a chlorine solution controls iron bacteria growths in the well, pump and distribution system. It also oxidizes inorganic iron.

The exchange softener tanks provided by soft water service operators sometimes contain a fine filtering material on top of the zeolite bed. This reduces or eliminates zeolite fouling by the oxidized iron.

### Oxidizing Filter

If the iron content of your water is greater than the softener manufacturer states his equipment will remove—or if the iron is already partly oxidized—you may need an oxidizing filter ahead of the water softener.

An oxidizing filter removes most of the oxidized and dissolved iron in concentrations of 10 ppm. or less. The water softener will generally take out any remaining iron which passes through the filter.

Most oxidizing filters contain greensand—a sand that has a natural chemical make-up that causes manganic oxides to bond to its surface. These oxides then convert the dissolved iron to the oxidized form. The greensand bed holds the oxidized iron until the filter is backwashed. Frequent backwashings helps prevent an iron-fouled greensand bed. After four or five backwashings, the greensand usually needs regeneration with potassium permanganate.

Because backwashing is such an important part of keeping an oxidizing filter functioning properly, be sure your pumping rate is adequate before investing in a filter. Most oxidizing filters fail because there is not enough water flow for proper backwashing.

Oxidation of the iron either by aeration or chlorination before the water gets to the oxidizing filter doesn't interfere with iron removal by the filter. But if the water is acid it may prevent the iron from oxidizing in the fllter.

Most groundwater in Iowa is neutral or alkaline, and slightly alkaline (pH more than 7.2) is best for fast iron oxidation. Testing to see if your water is acid is best done right at the well site by someone dealing in water equipment.

To correct an acid condition, feed soda ash (sodium carbonate) into the well with a solution feeder, or install a neutralizer tank containing limestone (calcium car-

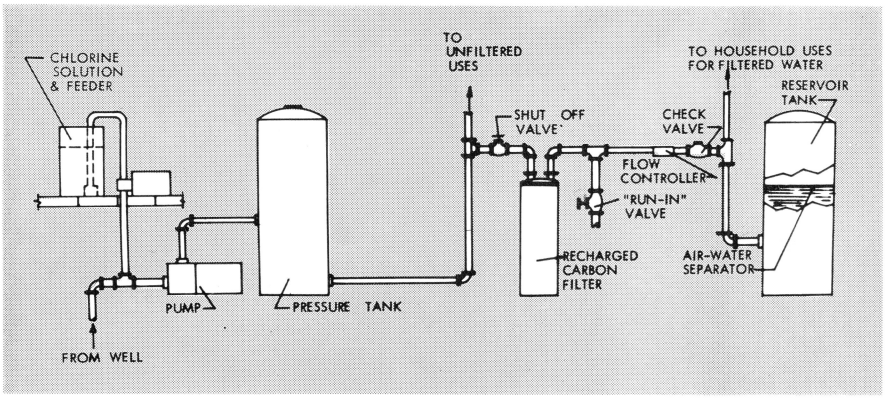



**FIGURE 4.** A carbon filter removes iron oxidized by the chlorine solution and the chlorine taste and odor. Carbon filters may be of the backwash type or may be manually cleaned and recharged.

bonate) chips ahead of the oxidizing filter. Adding sodium carbonate doesn't increase water hardness, but adding calcium carbonate does.

An oxidizing filter won't operate satisfactorily on every water system. For instance, if there's hydrogen sulfide or other reducing agents present in the water supply, they will quickly exhaust a filter bed. Also, iron bacteria and other slime organisms clog the bed rapidly.

### Aeration and Settling

With aeration and settling, dissolved iron in the groundwater is exposed to atmospheric air so it is oxidized and settles to the bottom of a large storage tank. The tank should have at least a 5,000-gallon capacity. Running water through a fine spray nozzle or a commercially available aerator exposes the water to air as it enters the tank.

Aeration of this type also removes undesirable gases that are sometimes present in groundwater supplies. These gases include carbon dioxide, which causes acid water; methane, which is explosive; and hydrogen sulfide, which is smelly and tarnishes silverware.

Clean out the iron sediment that settles in the tank periodically. Then chlorinate the tank before putting it back into service. If this is your drinking water supply for the home, continuous chlorination is important to destroy bacteria which can enter the water during aeration.

### Pressure Aeration and Filtration

Another alternative is pressure aeration and filtration. In this treatment, excess air is forced into the pressure tank to oxidize dissolved iron. The oxidized iron is then removed by a filter containing anthrafilt or sand. Anthrafilt, which is made from anthracite coal, is better than sand because a lesser pumping rate is needed to backwash the filter.

Excess air can be introduced with the pumped water. This is more easily done with a submersible pump than with other types. Another way to force the air into the pressure tank is with an air compressor.

### Chlorination and Filtration

Chlorination followed by filtration removes practically all forms of iron and destroys iron bacteria. Use a solution feeder to inject chlorine solution into the well (or at the pump as a second choice), and install a carbon filter to remove oxidized iron and excess chlorine.

If the water is acid, mix soda ash with the chlorine solution. This will neutralize the water. Both can be fed into the well through a single solution feeder.

Such treatment protects the pump and distribution system from acid corrosion and from contamination with disease-causing organisms. It also protects against nuisance bacteria such as sulfate-reducing bacteria, slime bacteria and iron bacteria. These cause odor, corrosion and pipe clogging. Hydrogen sulfide is also oxidized by the chlorine and removed by filtration.

Fresh chlorine solution should be mixed about every week or so. This may be common laundry bleach and water.

The carbon filter will remove not only the oxidized iron and the excess chlorine from your water, but also many other tastes and odors. Carbon filters may be of the back wash type or be manually cleaned.

### Equipment for Iron Removal

Equipment for removing iron from your water is available from retailers of water treatment materials. Ask your retailer for a performance guarantee for the specific water properties and intended usage of your water system before you buy.

Remember—the selection and size of equipment required to most satisfactorily correct your particular problem must be based on an investigation of your water system and an analysis of your water. However, trial and error cannot always be avoided in finding the best combination of equipment for your particular situation.

Be wary of spectacular claims for chemicals and equipment. Numerous water treatment gadgets have been marketed in recent years. Seek advice from sources of unbiased information.

Some water treatment equipment is available on a rental or exchange service basis. However, some equipment, such as a solution feeder, is not now available as rental equipment.

Before you buy, check to see if you can try various combinations of equipment to determine which combination gives the most satisfactory results. As you compare, you may find a water conditioning exchange service or equipment rental to be more convenient and less expensive than personal ownership where you have all the maintenance problems yourself.

Either way, coping with Iowa's iron problems in the water is not always a simple task to solve. But solutions are available.